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NATIONAL EUTROPHICATION SURVEY

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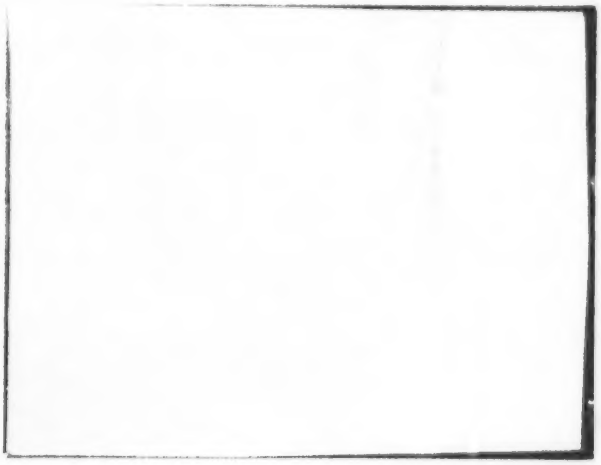

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REPORT
ON
WHITMAN LAKE
NELSON AND WALSH COUNTIES
NORTH DAKOTA
EPA REGION VIII
WORKING PAPER No. 578

WITH THE COOPERATION OF THE
NORTH DAKOTA STATE DEPARTMENT OF HEALTH
AND THE
NORTH DAKOTA NATIONAL GUARD
OCTOBER, 1976

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the North Dakota State Department of Health for professional involvement, to the North Dakota National Guard for conducting the tributary sampling phase of the Survey, and to those North Dakota wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

Norman L. Peterson, Director, and the staff of the Division of Water Supply and Pollution Control of the Department of Health, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

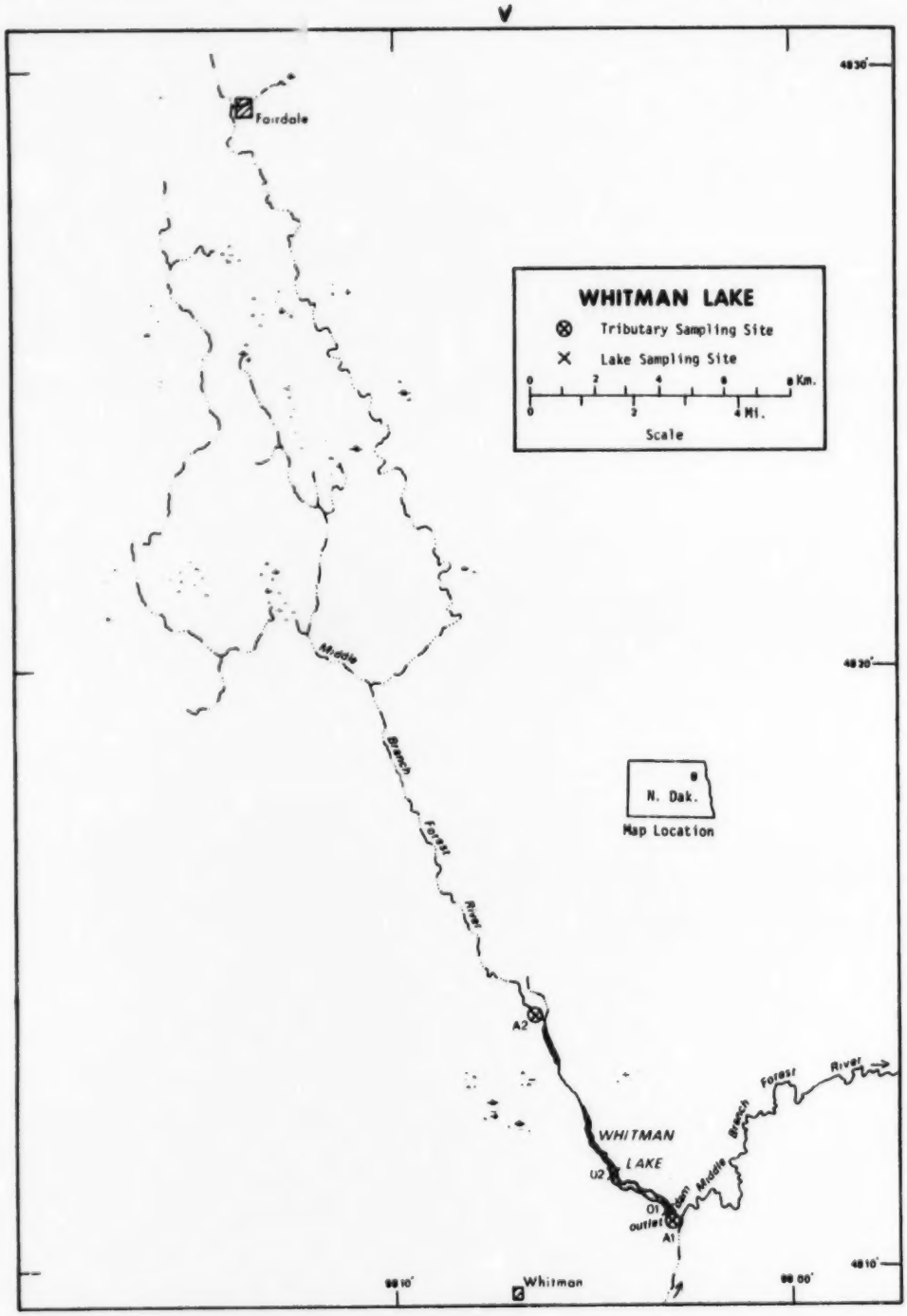
Major General LaClair A. Melhouse, the Adjutant General of North Dakota, and Project Officer Colonel Irvin M. Sande, who directed the volunteer efforts of the North Dakota National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES AND RESERVOIRS

STATE OF NORTH DAKOTA

NAME	COUNTY
Ashtabula	Barnes, Griggs
Audubon	McLean
Brush	McLean
Darling	Renville, Ward
Devils	Benson, Ramsey
Jamestown	Stutsman
LaMoure	LaMoure
Matejcek	Walsh
Metigoshe	Bottineau
Pelican	Bottineau
Sakakawea	Dunn, McKenzie, McLean, Mercer, Mountrail, Williams
Spiritwood	Stutsman
Sweet Briar	Morton
Whitman	Nelson, Walsh


WHITMAN LAKE
Tributary Sampling Site
Lake Sampling Site
0 2 4 6 8 Km.
0 2 4 Mi.
Scale
N. Dak.
Map Location
Fairdale
Whitman
Middle Branch Forest River
WHITMAN LAKE
A2
U2
O1
outlet
A1
48°30'
48°20'
48°10'
99°10'
99°00'

WHITMAN LAKE

STORET NO. 3815

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Whitman Lake is eutrophic. It ranked eleventh in overall trophic quality when the 14 North Dakota lakes sampled in 1974 were compared using a combination of six parameters*. Nine of the lakes had less and one had the same median total phosphorus, 11 had less median dissolved orthophosphorus, nine had less median inorganic nitrogen, seven had less mean chlorophyll a, and all of the other lakes had greater mean Secchi disc transparency. Depletion of hypolimnetic dissolved oxygen was not observed but has been reported to occur (Peterson, 1975).

Survey limnologists noted the presence of emergent aquatic vegetation near both sampling stations on all three sampling occasions (however, the vegetation observed in April was dead). Heavy algal blooms were observed in the lake in July and September.

B. Rate-Limiting Nutrient:

The algal assay results indicate that the lake was nitrogen limited in April and September when the assay samples were collected. The lake data indicate nitrogen limitation all three sampling times.

---

* See Appendix A.

C. Nutrient Controllability:

1. Point sources--No significant point sources are known to impact Whitman Lake.

2. Non-point sources--Non-point sources accounted for an estimated 99% of the total phosphorus load received by the lake during the sampling year. Most of this (about 89%) was contributed by the Middle Branch of the Forest River.

The estimated phosphorus loading of 0.83 $g/m^2/yr$ is over two times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 11). A large reduction in this loading probably would be necessary to improve the trophic condition of the lake noticeably. However, since much of the phosphorus load results from agricultural practices (Peterson, 1974), this may be difficult to achieve.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 0.58 kilometers^2.
2. Mean depth: 2.7 meters.
3. Maximum depth: 7.7 meters.
4. Volume: 1.566×10^6 m^3.
5. Mean hydraulic retention time: 255 days (based on outflow).

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Middle Branch Forest River	101.0	0.074
Minor tributaries & immediate drainage -	9.8	0.007
Totals	110.8	0.081

2. Outlet -

Middle Branch Forest River	111.4**	0.071

C. Precipitation***:

1. Year of sampling: 31.7 centimeters.
2. Mean annual: 44.7 centimeters.

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† Table of metric conversions--Appendix B.
†† Henegar, 1975.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Whitman Lake was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two or more depths at two stations on the lake (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first and last visits, single 18.9-liter depth-integrated samples were composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 4.9 meters at station 1 and 2.4 meters at station 2.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR WHITMAN LAKE
STORET CODE 3815

	1ST SAMPLING (4/29/74) 2 SITES			2ND SAMPLING (7/16/74) 2 SITES			3RD SAMPLING (9/16/74) 2 SITES		
AMETER	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN
P (C)	8.7 - 11.0	9.8	9.6	21.9 - 23.8	22.6	22.0	12.4 - 14.5	13.4	13.3
S OXY (MG/L)	5.8 - 9.0	7.4	8.4	5.8 - 7.8	6.7	6.0	8.6 - 10.0	9.4	9.4
CTVY (MCROMO)	263. - 300.	281.	278.	501. - 520.	509.	503.	403. - 413.	407.	409.
(STAND UNITS)	7.6 - 7.8	7.7	7.7	8.3 - 8.7	8.5	8.5	8.8 - 8.9	8.8	8.8
ALK (MG/L)	96. - 105.	100.	101.	181. - 186.	183.	182.	197. - 238.	223.	228.
P (MG/L)	0.233 - 0.272	0.254	0.257	0.281 - 0.347	0.316	0.315	0.216 - 0.285	0.249	0.245
HO P (MG/L)	0.180 - 0.203	0.190	0.185	0.235 - 0.259	0.243	0.240	0.131 - 0.150	0.141	0.145
+NO3 (MG/L)	1.110 - 1.450	1.306	1.330	0.060 - 0.110	0.082	0.090	0.020 - 0.020	0.020	0.020
IONIA (MG/L)	0.200 - 0.240	0.218	0.220	0.040 - 0.180	0.122	0.170	0.030 - 0.100	0.044	0.030
L N (MG/L)	1.000 - 1.600	1.180	1.100	0.800 - 1.100	0.880	0.800	1.200 - 1.900	1.440	1.300
RG N (MG/L)	1.330 - 1.690	1.524	1.540	0.100 - 0.280	0.204	0.260	0.050 - 0.120	0.064	0.050
AL N (MG/L)	2.330 - 2.710	2.486	2.460	0.890 - 1.160	0.962	0.910	1.220 - 1.920	1.460	1.320
RPYL A (UG/L)	3.5 - 3.7	3.6	3.6	9.0 - 77.2	43.1	43.1	32.1 - 36.9	34.5	34.5
CHI (METERS)	0.5 - 0.5	0.5	0.5	0.5 - 0.9	0.7	0.7	0.5 - 0.6	0.5	0.5

Reproduced from best available copy.

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/29/74	1. Chlamydomonas sp.	163
	2. Cryptomonas sp.	122
	3. Melosira sp.	82
	4. Nitzschia sp.	82
	5. Stephanodiscus sp.	82
	Other genera	203
	Total	734
07/16/74	1. Anabaena sp.	1,006
	2. Aphanizomenon sp.	931
	3. Cryptomonas sp.	782
	4. Trachelomonas sp.	261
	5. Schroederia sp.	186
	Other genera	1,156
	Total	4,322
09/16/74	1. Aphanizomenon sp.	9,542
	2. Anabaena sp.	585
	3. Oocystis sp.	410
	4. Dactylococcopsis sp.	176
	5. Stephanodiscus sp.	176
	Other genera	468
	Total	11,357

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
04/29/74	1	3.7
	2	3.5
07/16/74	1	9.0
	2	77.2
09/16/74	1	32.1
	2	36.9

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. April sample -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.145	1.335	28.8
0.050 P	0.195	1.335	32.4
0.050 P + 1.0 N	0.195	2.335	60.0
1.0 N	0.145	2.335	48.6

b. September sample -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.150	0.222	3.6
0.050 P	0.200	0.222	3.3
0.050 P + 1.0 N	0.200	1.222	15.1
1.0 N	0.150	1.222	13.4

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potential primary productivity of Whitman Lake was high at the times the assay samples were collected (04/29/74 and 09/16/74). Also, significant increases in yield with the addition of nitrogen alone indicate that the lake was limited by nitrogen at those times. Note that the addition of phosphorus alone resulted in yields not significantly greater than those of the controls.

The lake data also indicate nitrogen limitation; i.e., the mean inorganic nitrogen to orthophosphorus ratios were 9 to 1 or less each sampling time.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, when possible the North Dakota National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff month of May when two samples were collected. Sampling was begun in September, 1974, and was completed in August, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the North Dakota District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were calculated using mean annual concentrations and mean annual flows. Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the mean concentrations in the Middle Branch Forest River at station A-2 and the mean annual ZZ flow.

A. Waste Sources:

1. Known municipal - None
2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Middle Branch Forest River	425	88.5
b. Minor tributaries & immediate drainage (non-point load) -	40	8.3
c. Known municipal STP's - None	-	-
d. Septic tanks* -	5	1.1
e. Known industrial - None	-	-
f. Direct precipitation** -	10	2.1
Total	480	100.0

2. Outputs -

Lake outlet - Middle Branch Forest River	520

3. Net annual P loss - 40 kg.

* Estimate based on three shoreline picnic areas; see Working Paper No. 175.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Middle Branch Forest River	4,200	78.6
b. Minor tributaries & immediate drainage (non-point load) -	410	7.7
c. Known municipal STP's - None	-	-
d. Septic tanks* -	105	2.0
e. Known industrial - None	-	-
f. Direct precipitation** -	625	11.7
Total	5,340	100.0

2. Outputs -

Lake outlet - Middle Branch Forest River	5,340

3. Net annual N accumulation - none.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Middle Branch Forest River	4	42

* Estimate based on three shoreline picnic areas; see Working Paper No. 175.
** See Working Paper No. 175.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	0.83	loss*	9.2	none

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Whitman Lake:	
"Dangerous" (eutrophic loading)	0.38
"Permissible" (oligotrophic loading)	0.19

* There was an apparent loss of phosphorus during the sampling year. This may have been due to solubilization of previously sedimented phosphorus, unknown and unsampled point sources discharging directly to the lake, or underestimation of the minor tributary and immediate drainage load.

V. LITERATURE REVIEWED

Henegar, Dale, 1975. Personal communication (lake morphometry). ND Game & Fish Dept., Bismarck.

Peterson, Norman L., 1974. Personal communication (nutrient sources in the Whitman Lake drainage basin). ND Dept. of Health, Bismarck.

_____, 1975. Personal communication (ND lake trophic rankings). ND Dept. of Health, Bismarck.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

AKE DATA TO BE USED IN RANKINGS

AKE ODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
801	LAKE ASHTABULA	0.260	0.160	472.250	40.892	10.600	0.170
802	LAKE AUDUBON	0.087	0.220	446.222	11.322	11.000	0.015
803	BRUSH LAKE	0.066	0.095	449.143	29.114	9.000	0.010
804	LAKE DARLING	0.274	0.250	466.750	60.075	11.600	0.180
805	DEVILS LAKE	0.630	0.140	449.333	38.508	14.600	0.469
806	JAMESTOWN RESERVOIR	0.144	0.365	438.667	19.400	8.800	0.078
807	LAKE LA MOURE	0.438	0.380	421.400	19.720	15.000	0.290
808	MATEJCEK LAKE	0.228	0.440	475.167	2.683	14.400	0.179
809	LAKE METIGOSHE	0.032	0.080	389.167	10.367	9.000	0.010
811	PELICAN LAKE	0.034	0.070	364.500	10.950	12.800	0.006
812	LAKE SAKAKAWEA (GARRISON	0.016	0.150	408.733	6.883	10.800	0.007
813	SPIRIT WOOD LAKE	0.156	0.290	417.833	34.667	15.000	0.082
814	SWEET BRIAR RESERVOIR	0.092	0.090	440.800	39.000	8.800	0.031
815	WHITMAN LAKE	0.260	0.260	478.333	27.067	9.200	0.185

ENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
3801	LAKE ASHTABULA	27 (3)	54 (7)	15 (2)	8 (1)	62 (8)	38 (5)	204
3802	LAKE AUDUBON	69 (9)	46 (6)	46 (6)	69 (9)	46 (6)	69 (9)	345
3803	BRUSH LAKE	77 (10)	77 (10)	38 (5)	38 (5)	81 (10)	81 (10)	392
3804	LAKE DARLING	15 (2)	38 (5)	23 (3)	0 (0)	38 (5)	23 (3)	137
3805	DEVILS LAKE	0 (0)	69 (9)	31 (4)	23 (3)	15 (2)	0 (0)	138
3806	JAMESTOWN RESERVOIR	54 (7)	15 (2)	62 (8)	62 (8)	96 (12)	54 (7)	343
3807	LAKE LA MOURE	8 (1)	8 (1)	69 (9)	54 (7)	4 (0)	8 (1)	151
3808	MATEJCEK LAKE	38 (5)	0 (0)	8 (1)	100 (13)	23 (3)	31 (4)	200
3809	LAKE METIGOSHE	92 (12)	92 (12)	92 (12)	85 (11)	81 (10)	81 (10)	523
3811	PELICAN LAKE	85 (11)	100 (13)	100 (13)	77 (10)	31 (4)	100 (13)	493
3812	LAKE SAKAKAWEA (GARRISON	100 (13)	62 (8)	85 (11)	92 (12)	54 (7)	92 (12)	485
3813	SPIRIT WOOD LAKE	46 (6)	23 (3)	77 (10)	31 (4)	4 (0)	46 (6)	227
3814	SWEET BRIAR RESERVOIR	62 (8)	85 (11)	54 (7)	15 (2)	96 (12)	62 (8)	374
3815	WHITMAN LAKE	27 (3)	31 (4)	0 (0)	46 (6)	69 (9)	15 (2)	188

LAKES RANKED BY INDEX NOS. 16.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	3809	LAKE McTIGOSHE	523
2	3811	PELICAN LAKE	443
3	3812	LAKE SAKAKAWEA (GARRISON	405
4	3803	BRUSH LAKE	392
5	3814	SWEET BRIAR RESERVOIR	374
6	3802	LAKE AUDUBON	345
7	3806	JAMESTOWN RESERVOIR	343
8	3813	SPIRIT WOOD LAKE	227
9	3801	LAKE ASHTABULA	204
10	3808	MATEJCEK LAKE	200
11	3815	WHITMAN LAKE	188
12	3807	LAKE LA MOURE	151
13	3805	DEVILS LAKE	138
14	3804	LAKE DARLING	137

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR NORTH DAKOTA 03/16/76

LAKE CODE 3815 WHITMAN DAM

20.

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 111.4

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
3815A1	111.4	0.0	0.0	0.076	0.566	0.142	0.042	0.017	0.014	0.0	0.0	0.0	0.0	0.071
3815A2	101.0	0.0	0.0	0.076	0.566	0.150	0.054	0.023	0.017	0.0	0.0	0.0	0.0	0.074
3815ZZ	10.4	0.0	0.0	0.008	0.057	0.014	0.006	0.003	0.001	0.0	0.0	0.0	0.0	0.007

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 111.4
SUM OF SUB-DRAINAGE AREAS = 111.4
TOTAL FLOW IN = 0.98
TOTAL FLOW OUT = 0.86

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3815A1	9	74	0.001	21	0.001				
	10	74	0.001	21	0.001				
	11	74	0.002	21	0.002				
	12	74	0.001	21	0.001				
	1	75	0.001	18	0.001				
	2	75	0.000	23	0.0				
	3	75	0.0	24	0.0				
	4	75	0.042	6	0.0	20	0.0		
	5	75	0.212	4	0.708	20	0.014		
	6	75	0.003	23	0.003				
	7	75	0.184	21	0.170				
	8	75	0.001	23	0.001				
3815A2	9	74	0.0	21	0.0				
	10	74	0.0	21	0.0				
	11	74	0.0	21	0.0				
	12	74	0.0	21	0.0				
	1	75	0.0	18	0.0				
	2	75	0.0	23	0.0				
	3	75	0.0	24	0.0				
	4	75	0.237	6	0.0	20	0.227		
	5	75	0.113	20	0.001				
	6	75	0.019	23	0.024				
	7	75	0.187	21	0.026				
	8	75	0.000	23	0.0				
3815ZZ	9	74	0.0						
	10	74	0.0						
	11	74	0.0						
	12	74	0.0						
	1	75	0.0						
	2	75	0.0						
	3	75	0.0						
	4	75	0.028						
	5	75	0.014						
	6	75	0.003						
	7	75	0.014						
	8	75	0.0						

APPENDIX D

PHYSICAL and CHEMICAL DATA

TORET RETRIEVAL DATE 76/03/16

22. 381501
48 11 06.0 098 04 30.0 4
MITMAN LAKE
38063 NORTH DAKOTA

11EPALES 2111202
0020 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/29	10	10 0000	8.7		18	264	7.75	98	0.220	1.600	1.110	0.184
	10	10 0005	8.7	9.0		263	7.75	101	0.220	1.100	1.360	0.203
	10	10 0015	8.7	5.8		265	7.70	96	0.240	1.000	1.450	0.197
74/07/16	14	10 0000	22.0	6.0	36	503	8.70	182	0.170	0.800	0.110	0.259
	14	10 0005	21.9	6.0		501	8.40	182	0.170	0.800	0.090	0.244
	14	10 0015	21.9	5.8		502	8.30	181	0.180	0.800	0.090	0.235
74/09/16	14	20 0000	13.8	10.0	22	413	8.83	228	0.030	1.900	0.020K	0.148
	14	20 0013	13.3	9.0		409	8.83	226	0.030	1.300	0.020K	0.150
	14	20 0016	12.9	8.6		403	8.83	197	0.100	1.200	0.020	0.145

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/29	10	10 0000	0.260	3.7	
	10	10 0005	0.257		
	10	10 0015	0.272		
74/07/16	14	10 0000	0.347	9.0	
	14	10 0005	0.300		1.0
	14	10 0015	0.281		
74/09/16	14	20 0000	0.285	32.1	
	14	20 0013	0.245		
	14	20 0016	0.245		

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/03/16

23. 381502
48 11 06.0 098 04 30.0 4
WHITMAN LAKE
38053 NORTH DAKOTA

11EPALES 2111202
0012 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/29	10 35	0000	11.0		18	300	7.70	105	0.200	1.200	1.280	0.180
	10 35	0002	11.0	8.2		300						
	10 35	0008	10.5	8.6		291	7.65	102	0.210	1.000	1.330	0.185
74/07/16	14 30	0000	23.8	7.8	18	518	8.60	185	0.050	1.100	0.060	0.235
	14 30	0008	23.6	7.8		520	8.50	186	0.040	0.900	0.060	0.240
74/09/16	14 35	0000	14.5	10.0	18	409	8.87	228	0.030	1.600	0.020K	0.131
	14 35	0008	12.4	9.4		403	8.81	238	0.030	1.200	0.020K	0.133

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/29	10 35	0000	0.249	3.5	
	10 35	0008	0.233		
74/07/16	14 30	0000	0.315	77.2	
	14 30	0004			1.0
	14 30	0008	0.337		
74/09/16	14 35	0000	0.254	36.9	
	14 35	0008	0.216		

K VALUE KNOWN TO BE
LESS THAN INDICATED

APPENDIX E

TRIBUTARY DATA

TORET RETRIEVAL DATE 76/03/18

25.

381541
48 11 55.0 098 03 05.0 4
MID BRANCH FOREST RIVER
38 7.5 WHITMAN
U/WHITMAN DAM
BANK SAMP NEAR BASE OF WHITMAN DAM
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/09/21	10	33	0.060	0.600	0.015	0.050	0.100
74/10/21	12	05	0.100	1.100	0.045	0.103	0.115
75/05/04	10	40	0.700	2.600	0.230	0.220	0.280
75/05/20	11	00	0.130	2.400	0.017	0.035	0.200
75/06/23	11	15	0.065	4.500	0.570	0.270	0.440
75/07/21	10	04		1.750		0.125	0.200
75/08/23	09	34	0.300	1.750	0.417	0.230	0.290

ET RETRIEVAL DATE 76/03/18

26.

3815A2
48 14 15.0 098 06 35.0 4
MID BRANCH FOREST RIVER
38 7.5 WHITMAN
T/WHITMAN DAM
SEC RD 392 BRDG 5.5 MI N OF WHITMAN
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
75/05/20	11 15		0.070	1.950	0.020	0.015	0.070
75/06/23	11 40		0.025	1.950	0.095	0.060	0.130
75/07/21	11 18		0.005	1.400	0.035	0.033	0.350